IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of:

Naohisa KASAKO, et al.

Serial No.: 10/820,629

Filed: April 8, 2004

For: REMOTE STORAGE DISK CONTROL DEVICE WITH FUNCTION TO TRANSFER COMMANDS TO REMOTE STORAGE DEVICES

Art Unit: 2186

Examiner: To Be Assigned

Confirmation No.: 8503

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April 27, 2005
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Kimberly Yee
Name

Kimberly Yee 04/27/05
Signature Date

PETITION TO MAKE SPECIAL FOR NEW APPLICATION UNDER MPEP §708.02, VIII

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

I. Petition

Applicants hereby petition to make this new application, which has not received any examination by the Examiner, special.

II. Claims

Check and complete all applicable items (a) through (c).

(a) x All the claims in this case are directed to a single invention.

(b) x If the Office determines that all the claims presented are not obviously directed to a single invention applicant will make an election without traverse as a prerequisite to the grant of special status.

(c) __ The applicants submit a preliminary amendment concurrently.

III. Search

A. Check all applicable items (d) through (g)
A search has been made by

(d) __ the inventor
(e) __ attorney
(f) x professional searcher (search reports attached hereto)
(g) __ foreign Patent Office
in the following:

B. Complete all applicable items below
(h) x field of search:

Class:	Subclasses:
711	100, 111, 112, 113, 114, 118, 147, 151, 154, 161, 202

(i) __ publications:
(j) __ foreign patents:
(k) __ search by corresponding foreign Patent Office or at the former International Patent Institute at The Hague, Netherlands

C. Detailed discussion of the references
There is submitted herewith a detailed discussion of the references which discussion particularly points out how the claimed subject matter is distinguishable over the references. These references are also listed in the attached Information Disclosure Statement, Form PTO-1449.

D. Fee

The fee required by 37 CFR 1.17(i)(2) is to be paid by

x the attached check for $ 130.00.

x If there are any fees due in connection with the filing of this petition, please charge the fees to our Deposit Account No. 50-1314. A duplicate copy of this Petition is enclosed.

Respectfully submitted,

HOGAN & HARTSON L.L.P.

Date: April 27, 2005

By: _____

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DETAILED DISCUSSION OF THE REFERENCES AND COMPARISON TO THE PRESENT INVENTION

IV. Field of the Invention:

The present invention relates to a method for controlling a storage device system, a storage device system, and a storage device.

V. Related Background Art:

Disaster recovery in information processing systems is attracting attention. By using data stored in a storage device installed at a remote site when a primary site is hit by a disaster, processings that are performed at the primary site can be continued at the remote site. The information processing device at the primary site transfers a copy of data that is written in the storage device at the primary site to the information processing device at the remote site. The information processing device at the remote site that has received the copy of data sends a request to write the data in the storage device at the remote site. When data is stored as a backup, a substantially large amount of data flow occurs on the network between the information processing devices. This causes a variety of problems, such as an increased interface processing load on the information processing devices, delays in other data transmissions to be conducted between the information processing devices, and the like. Also, the method requires software to control data backup to be installed in each of the information processing devices. For this reason, management works such as upgrading the software and the like need to be performed on all of the information processing devices that execute data backup processings, which increases the management cost.

VI. The References:

A. The Bael '845 Reference:

USPN 5,155,845 to Beal et al. (Beal '845) relates to a data storage system for providing redundant copies of data on different disk drives. FIG. 1 shows a host processor 101 connected to Data Storage Control Unit DSC 105 by way of channel interface 104. *(See Beal '845, Col. 5, lines 44-48).* DSC 105 is in turn connected to DSC 107 by way of an "optical fiber" or "metallic conductors". *(See Beal '845, Col. 5, lines 51-56).* The DSC 105 transmits the received write request over data link 106 to DSC 107 which causes a duplicate copy of the record to be written. *(See Beal '845, Col. 6, lines 5-8).* FIG. 5 shows the DSC 105 of FIG. 3. The data links of 106-0 and 106-1, which extend to DSC 107, may be separated by a distance such as five thousand meters. *(See Beal '845, Col. 9, lines 35-37).*

The local volume identification in FIG. 17 field 2 identifies a phantom volume of DSC 105 having no physical correspondence in disk drives 109. Field 3 of FIG. 17 identifies the volume 111 of DSC 107 that is to be written when the user at a host processor 101 generates such a subsequently received write request. In other words, DSC 105 is conditioned by the receipt of the command sequence shown in FIGS. 14 through 17 to write a record accompanying each subsequently received write request directed to the phantom volume of DSC 105 to the specified remote volume 111 of DSC 107. *(See Beal '845, Col. 30, lines 49-59).*

DSC 105 receives each such subsequently received write request from a user at host processor 101 and transmits the message sequence about to be described over data link 106 to DSC 107. Since the subsequently received write request identifies the phantom volume of DSC 105, no disk drive 109 writes the received record. *(See Beal '845, Col. 30, lines 60-65).*

As understood, Bael '845 provides a regular dual copy service in which a received command is transferred to second disk drives and third disk drives. Bael '845 does not provide for transfer of a first command to a third storage device without transferring to the second storage device as claimed by the present invention.

B. The Stakutis '317 Reference:

USPN 6,694,317 to Stakutis et al. (Stakutis '317) relates to an apparatus for high-speed access to and sharing of storage devices on a networked digital data processing system. FIG. 1 shows a plurality of nodes 12-24 coupled via network pathways. *(See Stakutis '317, Col. 4, lines 8-12).* The nodes operate under the Microsoft Windows NT operating system. (See col. 4, lines 44-46. FIG. 2 shows pathway 46 which may be fibre channel, firewire, serial storage architecture bus, high speed Ethernet, high performance parallel interface bus, or other high-speed peripheral device bus. (See col. 5, lines 28-33. The system operates with conventional Windows NT layering. (See col. 7, lines 36-38. Some server requests are routed through the network topology, while others are bypassed. (See col. 8, lines 61-63. During a write step, a map is used to determine the actual blocks to locally write. *(See Stakutis '317, Col. 10, lines 54-56).*

As understood, Stakutis '317 allows a conventional bypass under a Windows NT environment. Stakutis '317 does not provide for transfer of a first command to a third storage device without transferring to the second storage device as claimed. Moreover, Stakutis '317 does not provide for transfer of a first command between a plurality of storage devices which each have a controller and a plurality of disk drives. As shown in FIG. 1, nodes 12-24 are coupled to storage devices 30-42. Nodes 16, 20 are also coupled to storage device 36, which is controlled by node 18. Nodes 16, 20 are referred to as "clients" and node 18 is referred to as a "server".

Coupling between the clients 16, 20 and the shared peripheral device 36 can be provided by any conventional peripheral device interconnect, though, preferably, it is provided by high-speed interconnects such as fibre channel, "firewire" (i.e., IEEE 1394 bus), serial storage architecture (SSA) bus, high-speed Ethernet bus, high performance parallel interface (HPPI) bus or other high-speed peripheral device bus. *(See Stakutis '317, Col. 4, lines 55 to col. 5, lines 4).*

C. <u>The O'Hare '915 Reference:</u>

USPAPN 2001/0050915 to O'Hare et al. (O'Hare '915) relates to a multi-path multi-hop remote data facility with a first data storage device being connected to a host. FIG. 1 shows multiple data storage devices 12,14,16 and 18, connected to N host computers. *(See O'Hare '915, paragraph [0031]).* The plurality of interconnected storage devices 12, 14, 16, and 18 may be accessed by the host computers indirectly through data storage of device 18. *(See O'Hare '915, paragraphs [0032], [0033]).* Alternatively, the data storage device may be accessed through a multi-hop or "pass through." *(See O'Hare '915, paragraph [0034]).* The host computer 20 uses connection identifiers to specify the pathway from the host computer 20 to the target device with only local 1 knowledge and not knowledge of system topology. *(See O'Hare '915, paragraph [0035]).* There may be three data storage connections, such as Remote Data Storage Facility (RDF) connections between two Symmetrix data storage devices, but no LAN or SAN connection. *(See O'Hare '915, paragraph [0061]).*

According to O'Hare '915, any one of a variety of different communication paths may be selected for sending communications between SYM 112a and SYM 112d. In forming a single communication path, multiple decisions may be made with respect to a selecting a path through an intermediate node and in selecting a communication connection when there are multiple connections between two nodes.

In establishing a communication path between SYMs 112a and 112d, a first decision is what SYM may serve as an intermediate node in forming the communication path. Once a particular node on the graph is determined corresponding to a particular SYM, if there is more than one type of communication connection, one communication connection is selected. For example, in forming the path between SYMs 112a and 112d, a first decision is to select an intermediate node from a particular set of candidates, which in this example is either SYM-2 112b or SYM-3 112c.

Once a determination as to which SYM is the intermediate node, a decision may be made as to whether there are multiple communication connections available connecting the current data storage device, or SYM, with the selected intermediate data storage device, or SYM. If SYM 112b is selected, one of the communications connections represented by edge 116a must be selected. Edge 116a connecting SYM 112a to SYM 112b may be one of the SAN, the LAN, or a data storage connection. One of these may be selected in forming the connection between SYM 112a and SYM 112b. This is an iterative process that may be performed in forming a communication path between a beginning node in the graph, such as SYM-1 112a, and a target or ending node in the graph corresponding to a target data storage device or SYM, such as SYM-4 112d. *(See O'Hare '915, paragraph [0063]).*

In addition, at step 132, a start node and a target node in the graph are determined. The start node and the target node may represent host computers, or a storage device. Control proceeds to step 134 where a variable "current node" is assigned to be the start node. Control proceeds to step 136 where intermediate node candidates following the current node are determined. With respect to the current node, all adjacent nodes representing other host computers, storage devices and the like are determined at step 136. At step 138, a determination is made as to whether there are multiple intermediate node candidates for the current node. For

the determination of candidates made at step 136, is there more than one intermediate node. If a determination is made at step 138 that there is only a single intermediate node, control proceeds to step 142 where that single intermediate node candidate is assigned to be the intermediate node. If a determination is made at step 138 that there is more than one intermediate node candidate, control proceeds to step 140 where an intermediate node is selected from the set of candidates determined at step 136.

At step 140 and 142, control proceeds to step 148 where a determination is made as to whether there are multiple communication connections as between the current node and the selected intermediate node. If there are multiple communication connections, such as a LAN, a SAN, and one or more data storage connections, control proceeds to step 144 where one of the multiple communication connections are selected. Otherwise, control proceeds to step 146 where the single communication connection is used as the single communication between the current node and the intermediate node. *(See O'Hare '915, paragraph [0065]).*

As understood, O'Hare '915 uses a host computer to direct the target device through a connection identifier. O'Hare '915 does not provide for transfer of a first command to a third storage device by way of operation of a first controller and a second controller without transferring to the second storage device as claimed. Moreover, O'Hare '915 does not provide for transfer of a first command to a third storage device by way of operation of a first controller without transferring to the second storage device which is nearer the first storage device than the third storage device. According to O'Hare '915, a data storage device includes machine executable code for determining whether a data operation request is a multipath multihop system call. A communication path is determined between the data storage device and a target data storage device. A first communication connection is determined between the data storage device and a second data storage device included in the

communication path. Machine executable code is also included for sending the data operation request to the second data storage device. *(See O'Hare '915, paragraph [0015]).*

D. The Kitamura '553 Reference:

USPAPN 2003/0163553 to Kitamura et al. (Kitamura '553) relates to a storage system and method of copying data. As shown in FIG. 1, a storage system includes a local file server 100 and a remote file server 200 connected by private line 500. *(See Kitamura '553, paragraph [0030]).* Private line 500 is a Fibre Channel. *(See Kitamura '553, paragraph [0032]).* File server 100 and remote file server 200 have similarly configured hardware. *(See Kitamura '553, paragraphs [0033], [0034]).* The remote copy controller 114 of the local-file server 100 issues the data transfer instruction requesting copy to the remote file server 200. *(See Kitamura '553, paragraph [0035]).* In the remote copying process, an initial copying process is first carried out where data of files written in local-file server 100 is copied to the remote file server 200. *(See Kitamura '553, paragraph [0045]).*

As understood, Kitamura '553 does not provide for transfer of a first command to a third storage device without transferring to the second storage device as claimed by the present invention.

E. The Ohno '764 Reference:

USPN 2003/0229764 to Ohno et al. (Ohno '764) relates to a data storage subsystem. A data storage subsystem with a remote-copy operation is performed from the first subsystem to both of the second and third subsystems in parallel. *(See Ohno '764, paragraph [0088]).* The third subsystem transfers the updated information received from the first subsystem to the fourth subsystem with use of the remote-copy function. *(See Ohno '764, paragraph [0088]).* During remote copy, when the third update system buffers the updated information, and stores it at the

same number as the target subsystems. *(See Ohno '764, paragraph [0095]).* This information is thus stored differently. *(See Ohno '764 paragraph [0035]).*

As shown in FIG. 8, storage system 150 includes first, second, third, and fourth data storage subsystems 11a to 11d. Data path 63 is used for the connection among the first, second, and third subsystems 11a, 11b, and 11c and between third and fourth subsystems 11c and 11d. A logical volume used by the host computer connected to first storage subsystem 11a can be remote-copied to second, third, and fourth subsystems. A remote-copy operation is done from first subsystem to both of second and third subsystems in parallel. Third subsystem transfers updated information received from first subsystem to fourth subsystem with use of the remote-copy function. *(See Ohno '764, paragraph [0088]).* As understood, Ohno '764 does not provide for transfer of a first command to a third storage device by way of operation of a first controller and a second controller without transferring to the second storage device as claimed by the present invention.

F. <u>The Watanabe '828 Reference:</u>

USPN 2005/0033828 to Watanabe (Watanabe '828) relates to a remote copy system having a first storage unit system and a second storage unit system connected to each other through a third storage unit system. *(See Watanabe '828, FIG. 1; paragraph [0032]).* The distance between the storage subsystems is long and exceeds fiber channel. *(See Watanabe '828, paragraph [0038]).* Connection may be by broadband circuit such as ATM, SONET, EWDM or IP. *(See Watanabe '828, paragraph [0038]).* To realize remote copy, the primary storage subsystem 104 executes a remote copy program 105a. *(See Watanabe '828, paragraph [0043]).* Each storage subsystem 104 includes a controller 201has one or more disk devices 210. *(See Watanabe '828, paragraph [0053]).* Protection data is Written to the

intermediate storage subsystem to assure security. *(See Watanabe '828, paragraph [00657]).*

As shown in FIG. 17, primary storage subsystem 104a and secondary storage subsystem 104b are coupled via a remote copy link 1701. Remote copy link 1701 is usable as (1) an alternating path for remote copy when an intermediate storage subsystem 104c becomes faulty, or (2) as a path for control information communication. *(See Watanabe '828, paragraph [0180]).*

For (1), in the event that a fault occurs in the intermediate storage subsystem 104c, and remote copy cannot be executed through the medium of the intermediate storage subsystem, the primary and secondary storage subsystems can execute remote copy by using the remote copy link 1701. When the remote copy link 1701 is used as the alternating path during the occurrence of a fault, asynchronous remote copy is used because the distance between the primary storage subsystem 104a and secondary storage subsystem 104b is long. *(See Watanabe '828, paragraph [0181]).*

For (2), during normal operation, control information 107 can be transmitted/received through asynchronous communication by using the remote copy link 1701. More specifically, the control information 107 can be forwarded from the primary storage subsystem 104a to the secondary storage subsystem 104b by using the remote copy link 1701. Also, messages other than data concerning update requests can be transmitted/received asynchronously between the primary and secondary storage subsystems by using the remote copy link 1701. By making communication between the primary storage subsystem 104a and the secondary storage subsystem 104b directly without routing through the intermediate storage subsystem, the data consistency check and transmission delay necessarily caused by routing through the intermediate storage subsystem 104c can be reduced. *(See Watanabe '828, paragraph [0182]).*

As understood, Watanabe '828 does not provide for transfer of a first command to a third storage device by way of operation of a first controller and a second controller without transferring to the second storage device as claimed. Moreover, Watanabe '828 does not provide for transfer of a first command which is sent from the information processing device to the third storage device. According to Watanbe '828, a first storage unit system and a second storage unit system are connected to each other through a third storage unit system. When executing a remote copy process, the first storage unit system responds to a write request received from a computer to transmit to the third storage unit system a journal having write data received from the computer and address information indicative of a storage position to which the write data is written to thereby write the journal to the third storage unit system. The second storage unit system receives control information issued by the first storage unit system to read and acquire the journal from the third storage system on the basis of the control information. Then, the second storage unit system follows the address information contained in the journal to write the write data contained in the journal to a disk inside the second storage unit system. *(See Watanabe '828, paragraph [0011]).*

G. <u>The Gagne '002 Reference:</u>

USPN 6,209,002 to Gagne et al. (Gagne '002) relates to a data processing network 20 with equipment located at a local or production site 21, such as a first remote site 22 and a second remote site 23. The first remote site 22 includes a BCV/R1 logical volume 34, which can be connected either to a R2 logical volume 32 or to a remote adapter 35. In a first operating mode, the BCV logical volume 34 synchronizes with the R2 logical volume 32. In a second operating mode with the BCV/R1 logical volume 34 attached to the remote adapter 35, data will transfer over another communications link 36 to a remote adapter 37 in the second remote site 23

for transfer to an R2 logical volume 40 or other data receiver. The second remote site 23 includes a host 41 and eliminates the need for the existence of the host 33 at the first remote site 22. Thus, the second remote site 23 becomes the restoration site or secondary site for operating on the data if a natural disaster occurs at the local production site 21. The second remote site includes an optional BCV/R1 logical volume 42, which could allow a replication of the function performed to a third remote site. *(See Gagne '002, Col. 4, lines 44-63).*

According to Gagne '002, a remote site includes the basic structure of the first remote site 22, that constitutes a data storage facility, and a first data store in the form of the R2 logical volume 32 for connection to the local production site 21 that can alter data. The BCV/R1 logical volume 34 constitutes a second data store. In response to a first command, the data store facility in the first remote site 22 operates in a first operating mode during which the R2 logical volume 32 receives data from the remote adapter 31 and thereby is responsive to changes made to the data in the R1 logical volume 26. This is accomplished synchronously so a high-speed communications link 30 is necessary. In this operating mode the BCV/R1 logical volume 34 is considered to be operating in its BCV or first operating mode. *(See Gagne '002, Col. 4, lines 64 to col. 5, lines 11).*

The BCV/R1 logical volume 34 can shift to a second, or R1, operating mode once synchronism is achieved in the first operating mode. In the second operating mode the first remote site transfers data from the BCV/R1 logical volume 34 through the remote adapter 35, communications link 36 and remote adapter 37 to the R2 logical volume 40. The timing of shifts from the first to the second operating modes will be determined by a system operator. Shifts from the second operating mode to the first operating mode are made after the data transfer to the R2 logical volume 40 is complete. The interval between shifts to the second operating mode

will be in terms of minutes, hours or even days depending upon the activity in the R2 logical volume 32. *(See Gagne '002, Col. 5, lines 12-25).*

Gagne '002 does not provide for transfer of a first command to a third storage device by way of operation of a first controller without transferring to the second storage device. According to Gagne '002, a data storage site remote from a data processing facility that alters data, such as a production facility, transfers data to another site remote from the data storage facility. The data storage facility at the remote site includes first and second data stores. The first data store receives data from the production site. A data change recorder identifies changes that the data processing facility makes in the first data store. A first operating control establishes a first operating mode during which the second data store receives data from the first data store according to the changes recorded in the change recording means. After this operation is complete, a second operating control can establish a second operating mode for copying data from the second data store to the other remote site according to the changes recorded in the data change recorder. *(See Gagne '002, Col. 2, lines 48-62).*

H. <u>The Fukuzawa '129 Reference:</u>

USPN 6,098,129 to Fukuzawa et al. (Fukuzawa '129) relates to a local controller-connected disk data 314 as shown in FIG. 4. The device address 400 is an identifier (ID) for discriminating a disk device to be read from or written into by a host computer such as the mainframe 101, and is the data also contained in the read/write request issued by the host computer such as the mainframe 101. Local controller connection data 401 is the data indicating whether or not the disk drive corresponding to the controller-connected disk data 314 is actually connected to a controller. A remote controller connection pointer 402 indicates whether or not the

controller-connected disk data 314 is assigned to a disk drive connected to a remote controller. *(See Fukuzawa '129, Col. 7, lines 25-38).*

In the case where the such data is assigned to a disk drive connected to a remote controller, the pointer indicates a corresponding remote controller-connected disk data 315. Otherwise, the pointer assumes a null value. In the case where the remote controller connection pointer 402 is valid, (i.e. in the case where the particular device address 400 is assigned to a disk device connected to a remote controller), it represents the state in which the local controller connection data 401 is not assigned. In the case where the remote controller connection pointer 402 is invalid, (i.e. in the case where the device address 400 is not assigned to a disk drive connected to a remote controller), the local controller connection data 401 may indicate the state of no-assignment. In other words, the device address 400 may be assigned to neither a disk device connected to a local controller nor a disk device connected to a remote controller. *(See Fukuzawa '129, Col. 7, lines 39-55).*

An attribute 403 is the data unique to a device including the interface, the function, the data format and the block length of the disk drive. The local controller-connected disk data 315 shown in FIG. 5 is the data corresponding to a disk drive not directly connected to the disk controller A 104. It follows therefore that the remote controller-connected disk data 315, on the other hand, is pointed to by any one of the local controller-connected disk data 314. A connection controller address 500 represents the address of a controller connected with a disk device corresponding to the remote controller-connected disk data 315. The address of the disk controller B 113 is stored as the connection controller address 500.

A disk address 501 represents the address assigned in the controller actually connected to a corresponding disk drive. The local controller-connected disk data 314 and the remote controller-connected disk data 315 are set from the service processor 109. The mainframe 101 recognizes that the disk drive group B 114

(disks C and D) is also connected to the disk controller A 104 through the disk controller B 113, as shown in FIG. 6, taking advantage of the local controller-connected disk data 314 and the remote controller-connected disk data 315 shown in FIGS. 4 and 5. The vacant address of disk drive available in the disk controller A 104 is assigned by the disk controller A 104 to a disk drive of the I/O subsystem for an open system. *(See Fukazawa '129, Col. 7, line 56 to Col. 8, line 20).*

Fukazawa '129 does not provide for transfer of a first command to a third storage device by way of operation of a first controller without transferring to the second storage device. According to Fukazawa, the mainframe 101 recognizes that the disk drive group B 114 (disks C and D) is also connected to the disk controller A 104 through the disk controller B 113, as shown in FIG. 6, taking advantage of the local controller-connected disk data 314 and the remote controller-connected disk data 315. The vacant address of disk drive available in the disk controller A 104 is assigned by the disk controller A 104 to a disk drive of the I/O subsystem for an open system. *(See Fukazawa '129, Col. 8, lines 10-20).*

I. <u>The Ichinomiya '096 Reference:</u>

USPN 5,664,096 to Ichinomiya, et al. (Ichinomiya '096) shows a disk array controller capable of preventing data distortion caused by an interruption of data write operation with the disk array controller responsive to an output request from the host computer for dividing data supplied from the host computer and parallel writing the divided data in the plurality of disk drives. The write status includes a first status representing a write completed status of each disk drive, a second status representing a writing status of each disk drive, and a third status representing a no write indication status of each disk drive. *(See Ichinomiya '096, Summary; Col. 4, lines 32-50).*

J. <u>The Ofek '497 Reference:</u>

USPN 6,101,497 to Ofek (Ofek '497) relates to a data network with data storage facilities for providing redundant data storage and for enabling concurrent access to the data for multiple purposes. A first data processing system with a first data facility stores a data base and processes transactions or other priority applications. A second data storage facility, that may be physically separated from the first data storage facility, mirrors the data in the first data storage facility. In a concurrent access operating mode, the second data storage facility makes the data available to an application concurrently with, but independently of, the operation of the other application. On completion of the concurrent operation, the second data storage facility can reconnect with and synchronizes with the first data storage facility thereby to reestablish the mirroring operation. *(See Ofek '497, Abstract and Summary).*

K. The Skazinski '099 Reference:

USPN 6,247,099 to Skazinski, et al. (Skazinski '099) relates to a method and computer program for maintaining cache coherency amongst a plurality of caching storage controllers. FIG. 4 shows that data is copied from local cache 107 of a controller which first receives a write into an alternate controller's cache 108. *(See Skazinski '099, Col. 6, lines 53-56).* FIG. 5 shows a procedure for data synchronization. First controller 106 receives a write and must allocate space, and the second controller receives the same write. (See col. 7,1.24-39. The second controller requests permission to ensure a lock request. *(See Skazinski '099, Col. 7, 24-39).* Cache data is then accepted. *(See Skazinski '099, Col. 7, lines 50-55).*

L. The Jiang '354 Reference:

USPN 6,453,354 to Jiang et al. (Jiang '354) relates to a first data mover computer services data access requests from a network client, and a second data mover computer is coupled to the first data mover computer for servicing data

access requests from the first data mover computer. The first data mover computer uses a connection-oriented protocol to obtain client context information and to respond to a session setup request from the client by authenticating the client. The first data mover computer responds to a file system connection request from the client by forwarding the client context information and the file system connection request to the second data mover computer. The first data mover computer maintains a connection between the first data mover computer and the second data mover computer when the client accesses the file system and the first data mover computer passes file access requests from the client to the second data mover computer and returns responses to the file access requests from the second data mover computer to the client. In a preferred embodiment, the connection-oriented protocol is the Common Internet File System (CIFS) Protocol, and multiple clients share a Transmission Control Protocol (TCP) connection between the first data mover computer and the second data mover computer by allocation of virtual channels within the shared TCP connection and multiplexing of data packets of the virtual channels over the shared TCP connection. *(See Jiang '354, Abstract and Summary).*

M. <u>The Milillo '109 Reference:</u>

USPN 6,457,109 to Milillo et al. (Milillo '109) relates to a method and apparatus in a data processing system for copying data. A request is received to copy data from a first storage system to second storage system. The request identifies a source volume on the first storage system and a target volume on the second storage system and wherein data is located on a first source volume in the first storage system. Data is transferred to a second source volume in the first storage system. A pair is automatically established between the second source volume and the target volume. The data for the request is copied from the second

source volume to the target volume after the pair has been automatically established. The pair is terminated after the data has been copied to the target volume. The requester originating the request is notified of the result of the copy operation. *(See Milillo '109, Abstract and Summary).*

N. The Ofek '935 Reference:

USPN 6,587,935 to Ofek (Ofek '935) relates to a data processing network including a local system and a geographically remote system. Each of the local and remote systems includes a data storage facility. The remote data storage facility mirrors the local data storage facility. In a normal operating mode, the local and remote systems operate in near synchronism or in synchronism. In an alternate operating mode, writing operations at the local system immediately update the storage devices in the local data storage facility. Transfers of corresponding data to the remote data storage facility are made independently of and asynchronously with respect to the operation of the local system. *(See Ofek '935, Abstract and Summary).*

O. The Halstead '367 Reference:

USPN 6,697,367 to Halstead et al. (Halstead '367) is related to computer system may include one or more hosts and a plurality of data storage devices for providing multihop system calls. The data storage devices are interconnected and also connected to the one or more hosts. The connections may be direct or indirect. Each data storage device classifies a data operation as a system call, a remote system call, or a multihop system call. If an operation is classified as a multihop system call by a first data storage device, a portion of the data associated with the multihop system call is removed and a second portion of the data is forwarded to a second data storage device as specified by a connection identifier included in the first portion. A recursive process of removing a first portion and forwarding a

second portion of data associated with the multihop system call is performed by each data storage device forwarded a second portion of data until a data storage device receives a second portion that is interpreted as a system call or a remote system call. *(See Halstead '367, Abstract and Summary).*

P. The Gallo '698 Reference:

USPN 6,813,698 to Gallo, et al. (Gallo '698) relates to concurrent configurations of drives of a data storage library with drives of a data storage library concurrently configured. A processor transmits library configuration data separately to each drive, initializes a first configuration process state, with a time-out period, for each drive. A drive responds with a status response, the first process state is updated to "completed". A request for drive unique information is transmitted to the responding drive, advancing the process to a second state. Each of the data storage drives is arranged to acknowledge receipt of the configuration data with a status response. *(See Gallo '698, Summary; Col. 7, lines 45-57).*

Q. The Ofek '890 Reference:

USPAPN 2002/0004890 to Ofek et al. (Ofek '890) relates to a system and method for providing on-line, real-time, transparent data migration from an existing storage device to a replacement storage device. The existing and replacement storage devices are connected as a composite storage device that is coupled to a host, network or other data processing system. The replacement storage device includes a table which identifies data elements that have migrated to the replacement storage device. When a host system makes a data transfer request for one or more data elements, the replacement storage device determines whether the data elements have been migrated. If the data elements have migrated, the replacement storage device responds to the data transfer request independently of any interaction with the existing storage device. If the data elements have not

migrated, the replacement storage device migrates the requested data elements and then responds to the data request and updates the data element map or table. When not busy servicing other requests, the replacement storage device operates in a background mode to migrate data elements so the data migration can occur concurrently with and transparently to system operations. *(See Ofek '890, Abstract and Summary).*

R. The Green '428 Reference:

USPAPN 2002/0194428 to Green (Green '428) relates to a client system makes a client request to read or write data according to a first protocol. The requests is received by an Array Management Controller which determines an associated storage location identifying at least one disk controller system and a corresponding memory location. The Array Management Controller translates the client request into a requests, which is sent to a disk controller system according to a second protocol. The disk controller system performs the client request and can perform parity calculation. The Array Management Controller combines the responses from each sent disk controller system request to generate a response into the client request. The client response is then sent to the client system according to a first protocol. A plurality of disk controller system can be used to perform parity calculations thereby reducing the parity calculations performed by the Array Management Controller. *(See Green '428, Abstract and Summary).*

S. The Weber '931 Reference:

USPAPN 2003/0105931 to Weber et al. (Weber '931) relates to an architecture for transparent mirroring and a method of providing data redundancy in a data storage system may include receiving a request by a first data storage device controller for data access operation. Data is written to a local storage device and a data access operation performed by a second data storage device controller

communicatively coupled to the first data storage device controller over an interconnect fabric simultaneously. The second data storage device controller communicatively coupled to a second data storage device. *(See Weber '931, Abstract and Summary).*

T. The Hirakawa '064 Reference:

USPAPN 2003/0185064 to Hirakawa et al. (Hirakawa '064) relates to a clustering storage system that operates a plurality of storage system units as a single storage system, presents connection information between clustering storage systems to a user and receives data to be backed up and an instruction about a path between the clustering storage systems from the user. The clustering storage system uses load information or a transfer speed of a data connection line between the storage system units to determine a path between the clustering storage systems used for backup and a storage system unit for holding a backup copy so that the data transfer between the storage system units becomes minimum. The clustering storage system mainly uses the determined path for backing up the data. *(See Hirakawa '064, Abstract and Summary).*

U. The Ohno '077 Reference:

USPAPN 2003/0221077 to Ohno et al. (Ohno '077) relates to a method for controlling a storage system. FIG. 1 shows a host computer 30, and a first and a second storage control apparatuses 10 and 20 each having a function for receiving a data input/output request transmitted from the host computer. A first storage control apparatus 10 organizes one or more logical volumes 11 with each volume referred to by a logical unit number (LUN). *(See Ohno '077, paragraph [0076]).* FIG. 6 shows a data copy function for processing write-in requests. *(See Ohno '077, paragraph [0112]).* The first storage control apparatus 10 transmits to the second storage control apparatus 20 only the data stored in an updated storage area. *(See*

Ohno '077, paragraph [0126]). FIG. 7 shows a snapshot function wherein data is stored in cache memory 13" a write-in completion report is transmitted to host computer 30 after storage. *(See Ohno '077, paragraphs [0135]-[0137]).* An E-copy command pen its copying to be carried out between other devices. *(See Ohno '077, paragraph [0198]).* The E-copy command is transmitted from the first host computer 31, to a first storage control apparatus, a second storage control apparatus 20, and then to a third storage control apparatus 80. *(See Ohno '077, paragraphs [0200]-[0205]).*

V. The Yanai '831 Reference:

USPAPN 2004/0073831 to Yanai et al. (Yanai '831) relates to two data storage systems are interconnected by a data link for remote mirroring of data. Each volume of data is configured as local, primary in a remotely mirrored volume pair, or secondary in a remotely mirrored volume pair. A host computer directly accesses either a local or a primary volume, and data written to a primary volume is automatically sent over the link to a corresponding secondary volume. Each remotely mirrored volume pair can operate in a selected synchronization mode including synchronous, semi-synchronous, adaptive copy--remote write pending, and adaptive copy--disk. Direct write access to a secondary volume is denied if a "sync required" attribute is set for the volume and the volume is not synchronized. *(See Yanai '831, Abstract and Summary).*

W. The Suzuki '535 Reference:

USPAPN 2004/0078535 to Suzuki et al. (Suzuki '535) relates to a system where primary and secondary side systems are provided with plural control units. Primary side composite storage unit system has a plurality ("M" units; 1 to m) of primary side control units (210, 220, 230 and 240). *(See Suzuki '535, FIG. 1).* Each of the primary side control units is connected to processing unit 10. A secondary

side composite storage unit system has a plurality ("N" units; 1 to n) of secondary side control units (310, 320, 330 and 340). *(See Suzuki '535, FIG. 1).* With reference to FIG. 4, the secondary side control unit refers to sequential number 701 stored in write data management information table, and checks for a dropout. *(See Suzuki '535, paragraph [0046]).*

X. The Ofek '547 Reference:

USPAPN 2004/0098547 to Ofek et al. (Ofek '547) relates to a method and apparatus are disclosed for a computer system including host computers and storage elements. The host computers may be configured into a host domain and the storage elements configured into a storage domalines The storage domain includes a plurality of primary storage devices and a secondary storage device. The secondary storage device may be coupled to a plurality of the primary storage devices through a network. The secondary storage device may send and receive information from a heterogeneous set of host computers. Connections for transfer of data onto the secondary storage element are created automatically. *(See Suzuki '535, Abstract and Summary).*

Y. The Kaneko '026 Reference:

USPAPN 2004/0123026 to Kaneko (Kaneko '026) shows a control method for a storage device controller system with a first storage device controller that is connected to first and second storage devices storing data in the CKD format and the FBA format, respectively, and that has first and second communications control means that receive data input/output requests from a mainframe computer and an open system computer, respectively, and a second storage device that is connected to a third storage device storing data in the CKD format and that has third communications means connected to the second communications means, wherein the first storage device controller transmits a command to the second storage device

controller if a data read request received from the open system computer is for data stored on the third storage device, and transmits the data that are read out from the third storage device by the second storage device controller to the open system computer. *(See Kaneko '026, Abstract and Summary).*

Z. The Obara '652 Reference:

USPAPN 2004/0158652 to Ofek et al. (Ofek '652) relates to an online data migration method is provided for transferring data from a computer and an existing storage system using the conventional interface such as SCSI to a new storage system using SAN. The present method comprises the steps of disconnecting the connection between the computer and the first storage system with first interface protocol, connecting the computer to a switch connected to a second storage system with a second interface protocol through first protocol converter having protocol converting facility, connecting the switch to the first storage system through second protocol converter, and migrating data in the first storage system into the second storage system via the switch. *(See Kaneko '026, Abstract and Summary).*

AA. The Takeda et al. Reference:

USPAPN 2004/0193795 to Takeda et al. (Takeda '795) relates to a storage system a storage system where a plurality of storage control apparatuses are interconnected. FIG. 15 shows a configuration wherein a logical device 19z and a logical device 18 form a pair of logical devices. *(See Takeda '795, paragraph [0109]).* Logical device 19z has its data stored in a second storage device 5z, which is controlled by a fourth storage control apparatus 4z, while logical device 18 has its data stored in a first storage device 13. *(See Takeda '795, paragraph [0109]).* FIG. IS shows a control hierarchy in that a target command-processing unit processes a command received from a host apparatus. *(See Takeda '795, paragraph [0115]).*

BB. The Hirawaka '829 Reference:

USPAPN 2004/0267829 to Hirawaka et al. (Hirawaka '829) relates to a storage system that updates data stored as a journal. FIG. 1 shows original storage system 100A connected with secondary storage system 100B. The storage area is managed by partitioning. *(See Hirawaka '829, paragraph [0035]).* The set of logical volumes of the original volume and the secondary volume is a pair. *(See Hirawaka '829, paragraph [0038]).* Pointer information 700 is held for each group to manage the journal logical volume of the group. *(See Hirawaka '829, FIGS. 3 and 6; paragraph [0054]).* FIG. 9 shows that original storage system 110A initiates the initial copying process. *(See Hirawaka '829, FIG. 9, step 930; paragraph [0074]).* FIG. 10 shows the initial copying process. *(See Hirawaka '829, paragraph [0075]).* FIG. 13 shows a journal creation process. *(See Hirawaka '829, paragraph [0091]).* FIG. 11 shows command reception process 210. When the volume state of logical volume A is "normal," (step 1240), host computer 180 is notified, and the write data is transmitted. *(See Hirawaka '829, paragraph [0088]).*

CC. The Midori '521 Reference:

Japanese Patent App. Pub. No. 08-137772 to Midori (Midori '772) relates to an input/output control unit 4 in a beacon 1 that is carried by an operator, a memory for memorizing an ID code, and a CPU for control. The carrier wave of a specified frequency generated from a modulator by a frequency generator is modulated by the digital signal from the input/output control unit. The carrier wave is outputted through a sending/receiving wave distributor and an antenna for sending/ receiving. A sensor is mounted on an industrial robot side and includes an antenna for sending/receiving, a sending/receiving wave distributor, a receiving level detector, a demodulator, an input/output control unit, a frequency generator, and a modulator. In the case where it is detected that a human approaches a

machine exceeding a limit, operation of a machine side is stopped forcibly. *(See Midori '772, Abstract and Summary).*

VII. The Present Invention is Patentably Distinguishable Over the Above References

A. Embodiments of the Present Invention:

Claims 1-31 were originally pending in this application. Claims 1-31 were cancelled, and Claims 32-75 were added in a preliminary amendment dated December 15, 2004. Claims 32 and 54 are independent, and the remaining claims depend either directly or indirectly from these claims.

The present invention seeks to address the above deficiencies of the prior art. According to an embodiment of the present invention, independent Claim 32 defines a storage system having a first storage device coupled to an information processing device and having a first controller and a plurality of first disk drives. The first controller stores data received from the information processing device in the first disk drives and receives a first command and is able to transfer the first command to a Nth (N = positive integer of no fewer than 3) storage device without transferring the first command to a second storage device. The first command is sent from the information processing device to the Nth storage device. The second storage device is coupled to the first storage device and is nearer to the first storage device than the Nth storage device and has a second controller and a plurality of second disk drives. The second controller stores data in the second disk drives and is able to receive the first command from the first storage device and is able to transfer the first command to the Nth storage device. The Nth storage device is coupled to the second storage device or to a (N-1)th storage device and has a Nth controller and a plurality of Nth disk drives. The Nth controller stores data in the

Nth disk drives and receives the first command from the first storage device and executes the first command.

With such a storage system in accordance with the embodiment described above, the storage system includes a first storage device coupled to an information processing device and having a first controller and a plurality of first disk drives. A second storage device is coupled to the first storage device and also nearer to the first storage device than an Nth storage device, wherein N is a positive integer of at least 3 or more. The first controller is able to transfer the first command to the Nth storage device without transferring to the second storage device.

In one aspect of the present invention, referring to FIGS. 22 and 23, a synchronous pair is formed between first and second storage devices 10, 20 when these devices are located a short distance from each other. The information processing device 11 sends to second and third storage devices 20, 25 a command to form an asynchronous pair with the logical volume of the second storage device 20 being a primary volume and the logical volume of the third storage device 25 as being an auxiliary volume by using virtual volumes and command devices. After the asynchronous pair is formed, the information processing device 11 sends a command to obtain and restore a journal in the pair to the third storage device 25. Data of the first storage device 10 can be backed up in the third storage device 25 that may be installed at a great distance from the first storage device 10. Neither the third storage device 25 nor the second storage device 20, which is located intermediate between the first and third storage devices 10, 25, requires an information processing device. *(See Specification, page 37, lines 7-24).* An information processing device may be connected to either of these devices 10, 25 without departing from the scope of the present invention.

The information processing device 11 sends commands to the storage devices 10, 20, 25. The first storage device 10 can send a command to be executed at the

third storage device 25 via the virtual volume of the second storage device 20. By this, for example, the first storage device 10 can send to the third storage device 25 a command to confirm the operational status of the third storage device 25. If a failure occurs in the third storage device 25, the first storage device 10 can send to the second and third storage devices 20, 25 a command to cancel the asynchronous pair between the second and third storage devices 20, 25. *(See Specification, page 38, lines 4-20).*

In another aspect of the present invention, referring to FIGS. 35-37, first storage device 10 receives data 3501 of a command interface from the information processing device 11. The shared memory 204 of first storage device 10 stores a connection information management table 3601. The connection information management table 3601 stores addresses of the storage devices 10, 20 that are connected. For example, the connection information management table 3601 indicates that first storage device 10 is connected to second and third storage devices 20, 30. First storage device 10, upon receiving the data 3501 of the command interface from the information processing device 11, refers to connection information management table 3601 and obtains the address of third storage device 25, which is set at the last of the transfer destination parameter. First storage device 10 judges whether data can be directly sent to third storage device 25 because the address of third storage device 25 is stored in the connection information management table 3601. First storage device 10 generates data 3502 by deleting transfer destination addresses of third storage device 25 and second storage device 20, and directly sends data 3502 to third storage device 25 without passing it through second storage device 20. *(See Specification, page 49, line 12 to page 51, line 15).*

B. <u>Distinction over the cited references</u>

The cited references do not disclose or suggest the above features of the present invention. In particular, the cited references do not disclose or suggest that "said first controller controlling to store data received from said information processing device in said first disk drives and receiving a first command and being able to transfer said first command to a Nth (N = positive integer of no fewer than 3) storage device without transferring said first command to a second storage device, said first command being sent from said information processing device to said Nth storage device" as required by amended independent Claim 1 of the present invention. Moreover, the cited references do not disclose or suggest that "said second storage device being coupled to said first storage device and being nearer to said first storage device than said Nth storage device and having a second controller and a plurality of second disk drives," as required by amended independent Claim 1 of the present invention.

As discussed above, Bael '845 provides a regular dual copy service in which a received command is transferred to second disk drives and third disk drives. Bael '845 does not provide for transfer of a first command to a third storage device without transferring to the second storage device as claimed by the present invention.

As discussed above, Stakutis '317 allows a conventional bypass under a Windows NT environment. Stakutis '317 does not provide for transfer of a first command to a third storage device without transferring to the second storage device as claimed by the present invention. Moreover, Stakutis '317 does not provide for transfer of a first command between a plurality of storage devices which each have a controller and a plurality of disk drives.

As discussed above, O'Hare '915 uses a host computer to direct the target device through a connection identifier. O'Hare '915 does not provide for transfer of a first command to a third storage device by way of operation of a first controller

and a second controller without transferring to the second storage device as claimed. Moreover, O'Hare '915 does not provide for transfer of a first command to a third storage device by way of operation of a first controller without transferring to the second storage device which is nearer the first storage device than the third storage device.

As discussed above, Kitamura '553 relates to a remote copying process, wherein an initial copying process is first carried out where data of files written in local-file server 100 is copied to the remote file server 200. As understood, Kitamura '553 does not provide for transfer of a first command to a third storage device without transferring to the second storage device as claimed by the present invention.

As discussed above, Ohno '764 relates to a remote-copy operation that is done from first subsystem to both of second and third subsystems in parallel. Third subsystem transfers updated information received from first subsystem to fourth subsystem with use of the remote-copy function. As understood, Ohno '764 does not provide for transfer of a first command to a third storage device by way of operation of a first controller and a second controller without transferring to the second storage device as claimed by the present invention.

As discussed above, Watanabe '828 does not provide for transfer of a first command to a third storage device by way of operation of a first controller and a second controller without transferring to the second storage device as claimed. Moreover, Watanabe '828 does not provide for transfer of a first command which is sent from the information processing device to the third storage device.

As discussed above, Gagne '002 relates to a first operating control that establishes a first operating mode during which a second data store receives data from the first data store according to the changes recorded in the change recording means. After this operation is complete, a second operating control can establish a

second operating mode for copying data from the second data store to the other remote site according to the changes recorded in the data change recorder. As understood, Gagne '002 does not provide for transfer of a first command to a third storage device by way of operation of a first controller without transferring to the second storage device.

As discussed above, Fukazawa '129 relates to a mainframe 101 that recognizes when a disk drive group B 114 (disks C and D) is connected to a disk controller A 104 through the disk controller B 113. The vacant address of disk drive available in the disk controller A 104 is assigned by the disk controller A 104 to a disk drive of the I/O subsystem for an open system. As understood, Fukazawa '129 does not provide for transfer of a first command to a third storage device by way of operation of a first controller without transferring to the second storage device.

As with the above discussed references, the remaining cited references do not disclose or suggest all of the limitations of the present invention as required by independent Claim 32.

Therefore, since the cited references do not disclose or suggest all of the limitations of the present invention as required by independent Claim 32, these cited references cannot be said to anticipate nor render obvious the invention which is the subject matter of that claim.

Accordingly, independent Claim 32 is believed to be in condition for allowance and such allowance is respectfully requested.

Moreover, Applicant respectfully submits that independent Claim 54 is allowable for at least the same reasons as discussed above with reference to independent Claim 32.

The remaining Claims 33-53 and 55-75 depend either directly or indirectly from independent Claims 32 and 54 and recite additional features of the invention which are neither disclosed nor fairly suggested by the cited references.

Accordingly, these claims are believed to be in condition for allowance and such allowance is respectfully requested.

February 28, 2005

PRIVILEGED AND CONFIDENTIAL
ATTORNEY CLIENT INFORMATION

Mr. Noboru Otsuka
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IP Development & Management Division
Patent Department 4
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RE: Petition-To-Make-Special Search
For: **REMOTE STORAGE DISK CONTROL DEVICE WITH FUNCTION TO TRANSFER COMMANDS TO REMOTE STORAGE DEVICES**
Your Ref. No.: 340301257US02
Our Ref. No.: HIT 3176

Dear Mr. Otsuka:

We have completed the Petition to Make Special search at the U.S. Patent and Trademark Office regarding the above-identified invention. Enclosed with this letter are our draft Petition to Make Special, and paper and electronic copies of patents set forth in our search.

Proposed Amendment to Specification

Page 43, ln. 6, change "2808" to –2802--.
Page 43, ln. 12, after "deleting the," insert --address of the--.

Search Report

The field of search covered Class 711, subclass 112 (U.S. & Foreign). Additionally, a computer database search was conducted on the USPTO systems EAST and WEST for U.S. and foreign patents; a keyword search was conducted in Class 711, subclasses 113, 114, 118, 147, 161 and 202; and a literature search was also conducted on the Internet and commercial databases for relevant non-patent documents. Examiner Reginald Bragdon in Class 711 (Art Unit 2188) was consulted in confirming the field of search.

The search was directed towards a remote storage disk control device with function to transfer commands to remote storage devices. In particular, the search was directed towards claims 1, 19 and 20 of U.S. Application Number 10/820629. The claims describe storage system comprising: a first storage device coupled to an information processing device having a first controller and a plurality of first disk drives, the first disk drives are corresponding to a plurality of logical volumes which are able to have a first logical volume and a second logical volume; the first controller controlling to store data received from the information processing device in the first disk drives and receiving a first command sent from the information processing device and transferring at least a part of the first command to the second storage device, the first command being used to request a change of a first condition of the first logical volume and the second logical volume in the first storage device, the second storage device or a (N-1)th storage device and a change of a second condition of a third logical volume and a fourth logical volume in a Nth storage device; the second storage device coupled to the first storage device having a second controller and a plurality of second disk drives, the second disk drives are corresponding to a plurality of logical volumes which are able to have the first logical volume and the second logical volume; the second controller controlling to store data in the second disk drives and receiving at least a part of the first command from the first storage device and transferring at least a part of the first command to the Nth storage device; the Nth storage device coupled to the second storage device having a Nth controller and a plurality of Nth disk drives; and the Nth controller controlling to store data in the Nth disk drive and receiving at least a part of the first command from the second storage device or the (N-1)th storage device and controlling to change the second condition in response to at least part of the first command; wherein the first controller, the second controller or a (N-1)th storage controller changes the first condition in response to at least a part of the first command. The storage system comprises first storage device coupled to information processing device; second storage device coupled to the first storage device; and the third storage device coupled to the second storage device, and as further claimed in the disclosure.

Please note the enclosed documents listed in numerical order for convenience:

U.S. Patent Number	Inventor(s)
6,253,295	Beal et al.

Published Patent Application	Inventor(s)
2003/0185064	Hirakawa et al.*
2003/0221077	Ohno et al.*
2003/0229764	Ohno et al.*
2004/0123026	Kaneko*
2004/0193795	Takeda et al.*

*Patents assigned to Hitachi

Brief Description Of The Documents:

U.S. Patent Application Number 2003/0185064 (Hirakawa et al.) shows a method of copying data from one clustering storage system to another clustering storage system in a storage system, which is comprised of connecting a plurality of clustering storage systems having a plurality of storage system units. The storage system unit (210) of the clustering storage system (200) has port information (300), volume information (400), pair information (500), primary-to-secondary path information (600) and distance information (700) between storage system units. See figures, summary and sections [0035]-[0038].

U.S. Patent Application Number 2003/0229764 (Ohno et al.) shows a method for copying information from a first storage subsystem to a second storage subsystem, the first and second storage subsystems being provided in a data storage system, the method comprising: transmitting first data block from the first storage subsystem to the second storage subsystem, the first storage subsystem being associated with a first host computer and the second storage subsystem being associated with a second host computer; and transmitting first attribute information from the first storage subsystem to the second storage subsystem without intervention from the first host computer. See figures and sections [0025]-[0026].

U.S. Patent Application Number 2004/0193795 (Takeda et al.) shows a storage system, which manages a plurality of storage control apparatus in an integrated manner. An I/O request issued by a host apparatus to a second storage control apparatus is forwarded to the second storage control apparatus through a first storage control apparatus. The first storage control apparatus has management information for the second storage control apparatus, allowing a pair comprising a

logical device controlled by the first storage control apparatus and a logical device controlled by the second storage control apparatus to be created. See figures and summary.

U.S. Patent Application Number 2003/0221077 (Ohno et al.) shows a method for controlling a storage system including a host computer, and a first and a second storage control apparatuses each having a function for receiving a data input/output request transmitted from the host computer and executing a data input/output process for a storage device in response to the data input/output request received, comprising: connecting a first communication path between the host computer and the first storage control apparatus to each other; and connecting a second communication path between the first storage control apparatus and the second storage control apparatus to each other. See figures and sections [0012]-[0018].

U.S. Patent Application Number 2004/0123026 (Kaneko) shows a control method for a storage device controller system with a first storage device controller that is connected to first and second storage devices storing data in the CKD format and the FBA format, respectively, and that has first and second communications control means that receive data input/output requests from a mainframe computer and an open system computer, respectively, and a second storage device that is connected to a third storage device storing data in the CKD format and that has third communications means connected to the second communications means, wherein the first storage device controller transmits a command to the second storage device controller if a data read request received from the open system computer is for data stored on the third storage device, and transmits the data that are read out from the third storage device by the second storage device controller to the open system computer. See figures and summary.

U.S. Patent Number 6,253,295 (Beal et al.) shows a data storage system including first storage means, second storage means, third storage means and fourth storage means, the first and second storage means arranged to enable a mirroring of data therebetween using remote copy procedures so as to maintain a synchronism of data therebetween. See figures and summary.

While the above-noted Examiner was consulted and confirmed our opinion that the most relevant areas for this invention were reviewed, further searching may uncover additional patents. NOTE: The field of search included the most pertinent areas identified by the Examiner and our office as containing relevant patents.

As always, if you have any questions regarding this search, please do not hesitate to call us at (703) 413-5000.

Very truly yours,

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TWK/RCP/TEM/nsa
Enclosure

February 28, 2005

PRIVILEGED AND CONFIDENTIAL
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RE: Petition-To-Make-Special Search
For: **REMOTE STORAGE DISK CONTROL DEVICE AND METHOD FOR CONTROLLING THE SAME**
Your Ref. No.: 340300154US01
Our Ref. No.: HIT 3177

Dear Mr. Otsuka:

We have completed the Petition to Make Special search at the U.S. Patent and Trademark Office regarding the above-identified invention. Enclosed with this letter are our draft Petition to Make Special, and paper and electronic copies of patents set forth in our search.

The field of search covered Class 711, subclasses 111 (U.S. & Foreign), 112 (U.S. & Foreign) and 154 (U.S. & Foreign). Additionally, a computer database search was conducted on the USPTO systems EAST and WEST for U.S. and foreign patents; a keyword search was conducted in Class 711, subclasses 100, 113, 114 and 151 and a literature search was also conducted on the internet and commercial databases for relevant non-patent documents. Examiner David Robertson in Class 711 (Art Unit 2186) was consulted in confirming the field of search.

The search was directed towards a remote storage disk control device and method for controlling the same. In particular, the search was directed towards claims 1, 19, 20, 21 and 22 of U.S. Application Number 10/748,886. The claims describe a first storage device coupled to an information processing device and having a first controller and a plurality of first disk drives, the first controller controlling to store data received from the information processing device in the first disk drives and receiving a first command being used to request a status of a first logical volume in a second storage device, and transferring said command to the

second storage device, and second storage device coupled to first storage device having a second controller and a plurality of second disk drives, the second disk drives corresponding to a plurality of logical volumes which have the first logical volume, and second controller receiving a command from first storage device and replying the status of first logical volume to the information processing device via the first storage device in response to the command and as further claimed in the disclosure.

Please note the enclosed documents listed in numerical order for convenience:

U.S. Patent Number	Inventor(s)
5,155,845**	Beal, et al.
5,664,096 *	Ichinomiya, et al.
6,813,698	Gallo, et al.

Published Patent Application	Inventor(s)
2001/0050915**	O'Hare, et al.
2003/0163553 *	Kitamura, et al.
2003/0229764 *	Ohno, et al.
2005/0033828	Watanabe

*Patents assigned to Hitachi.
**Patents included in the IDS provided with the disclosure.

Brief Description Of The Documents:

U.S. Patent Number 5,664,096 (Ichinomiya, et al.) shows a disk array controller capable of preventing data distortion caused by an interruption of data write operation with the disk array controller responsive to an output request from the host computer for dividing data supplied from the host computer and parallel writing the divided data in the plurality of disk drives. The write status includes a first status representing a write completed status of each disk drive, a second status representing a writing status of each disk drive, and a third status representing a no write indication status of each disk drive. See summary, column 4, lines 32-50

U.S. Patent Number 6,813,698 (Gallo, et al.) shows concurrent configurations of drives of a data storage library with drives of a data storage library concurrently configured. A processor transmits library configuration data separately to each drive, initializes a first configuration process state, with a time-out period, for each drive. A drive responds with a status response, the first process state is updated to "completed". A request for drive unique information is transmitted to the responding drive,

advancing the process to a second state. Each of the data storage drives is arranged to acknowledge receipt of the configuration data with a status response. See summary, column 7, lines 45-57.

U.S. Patent Application Number 2005/0033828 (Watanabe) shows a first storage unit system and a second storage unit system connected to each other through a third storage unit system. When executing a remote copy process, the first storage unit system responds to a write request received from a computer to transmit to the third storage unit system a journal having write data received from the computer and address information indicative of a storage position to which the write data is written, thereby writing the journal to the third storage unit system. The second storage unit system receives control information issued by the first storage unit system to read and acquire the journal from the third storage system on the basis of the control information. Then, the second storage unit system follows the address information contained in the journal to write the write data contained in the journal to a disk inside the second storage unit system. See paragraphs 9, 10 and 11.

U.S. Patent Application Number 2001/0050915 (O'Hare, et al.) shows a multipath multihop remote data facility with a first data storage device being connected to said host, said data operation request being forwarded to said first data storage device and being a multipath multihop system call directing said third data storage device to respond to said data operation request, a depth or level of one associated with the data operation request indicates a first data storage device 32 where a system call may be used to issue a data operation to be performed. With a depth of two, for example, if the host processor 34 issues a data operation request to be performed by a second storage data device 36, a remote system call may be used. With a depth of three, the host processor 34 may use a multihop system call, for example, to issue a data operation request to be performed by the third data storage device 40. See paragraphs 8, 35, 46, and Claim 30

U.S. Patent Number 5,155,845 (Beal, et al.) shows a data storage system for providing redundant copies of data on different disk drive means unique to said third data storage control and operable independently of said first data storage control and said second data storage control and responsive to the reception of said write request and accompanying data record over said second data link transmission path for effecting the writing of said data record by a first recording element of said third recording means. See summary, and claims 3, 14, 27 and 34.

U.S. Patent Application Number 2003/0229764 (Ohno, et al.) shows a data storage subsystem with a remote-copy operation done from the first subsystem to both of the second and third subsystems in parallel and the third subsystem transfers

the updated information received from the first subsystem to the fourth subsystem with use of the remote-copy function. See paragraphs 88 and 96.

U.S. Patent Application Number 2003/0163553 (Kitamura, et al.) shows a storage system and method of copying data. The primary storage apparatus of the primary storage system comprises primary remote-copying means, and the secondary storage apparatus of the secondary storage system comprises secondary remote-copying means, and the primary control apparatus of the primary storage system comprises remote-copy controlling means for controlling the primary remote-copying means. The remote-copy controlling means sends, to the primary remote-copying means of the primary storage apparatus, a data-transfer instruction instructing the primary remote-copying means to transfer predetermined data stored in the primary storage apparatus to the secondary storage system; the primary remote-copying means receives the data-transfer instruction, reads out the predetermined data from the primary storage apparatus, and sends the data to the secondary remote-copying means of the secondary storage system via the communication line. See summary.

While the above-noted Examiner was consulted and confirmed our opinion that the most relevant areas for this invention were reviewed, further searching may uncover additional patents. NOTE: The field of search included the most pertinent areas identified by the Examiner and our office as containing relevant patents.

As always, if you have any questions regarding this search, please do not hesitate to call us at (703) 413-5000.

Very truly yours,

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TWK/RCP/TEM/nsa
Enclosure

March 4, 2005

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RE: Petition-To-Make-Special Search
For: **REMOTE STORAGE DISK CONTROL DEVICE AND METHOD FOR CONTROLLING THE SAME**
Your Ref. No.: 340300154US02
Our Ref. No.: HIT 3177.01

Dear Mr. Otsuka:

We have completed the Petition to Make Special search at the U.S. Patent and Trademark Office regarding the above-identified invention. Enclosed with this letter are our draft Petition to Make Special, and paper and electronic copies of patents set forth in our search.

Confirmation of our Understanding

We understand the term "instruction," on page 21, ln. 20 of the specification, to be a "command" that is sent from information processing device 11, and then executed by second storage device 20.

Search Report

The field of search covered Class 711, subclasses 111 (U.S. & Foreign), 112 (U.S. & Foreign) 154 (U.S. & Foreign). Additionally, a computer database search was conducted on the USPTO systems EAST and WEST for U.S. and foreign patents; a keyword search was conducted in Class 711, subclasses 100, 113, 114, 151 and a literature search was also conducted on the internet and commercial databases for relevant non-patent documents. Examiner David Robertson in Class 711 (Art Unit 2186) was consulted in confirming the field of search.

The search was directed towards a remote storage disk control device and method for controlling the same. In particular, the search was directed towards claims 1 and 20 of U.S. Application Number 10/748,886. The claims describe a first storage device, coupled to an information processing device, and having a first controller and a plurality of first disk drives. The first controller controlling to store data received from the information processing device in the first disk drives and receiving a first command being used to request a change of relationship between a first logical volume in a second storage device, and a second logical volume in said first storage device. The second storage device is coupled to the first storage device and has a second controller and a plurality of second disk drives. The second disk drives also correspond to a plurality of logical volumes that receive the first command from the first storage device, and then provide control to change the relationship between the first logical volume and second logical volume.

Please note the enclosed documents listed in numerical order for convenience:

U.S. Patent Number	Inventor(s)
5,155,845 **	Beal et al.
6,247,099	Skazinski et al.
6,813,698	Gallo et al.

Published Patent Application	Inventor(s)
2001/0050915 **	O'Hare et al.
2003/0163553 *	Kitamura et al.
2003/0229764 *	Ohno et al.
2005/0033828 *	Watanabe
2004/0267829 *	Hirawaka et al.

*Patents assigned to Hitachi.
**Patents included in the IDS provided with the disclosure.

Brief Description Of The Documents:

U.S. Patent No. 5,155,845 to Beal et al.

Beal et al. relates to a data storage system for providing redundant copies of data on different disk drives. FIG. 1 illustrates that DSC 105 (data storage control unit) is connected to host processor 101 and DSC 107 to transmit and receive read and write requests. See col. 5, ln. 56-68. FIG. 18 illustrates a sequence message 106 to be transmitted over a data link. See col. 25, ln. 59-63. As illustrated in FIG. 18, the state is "active." See col. 26, ln. 11-14.

U.S. Patent No. 6,247,099 to Skazinski et al.

Shazinski et al. relates to a method and computer program for maintaining cache coherency amongst a plurality of caching storage controllers. FIG. 4 illustrates that data is copied from local cache 107 of a controller which first receives a write into an alternate controller's cache 108. See col. 6, ln. 53-56. FIG. 5 illustrates a procedure for data synchronization. First controller 106 receives a write and must allocate space, and the second controller receives the same write. See col. 7, l. 24-39. The second controller requests permission to ensure a lock request. See col. 7, l. 24-39. Cache data is then accepted. See col. 7, ln. 50-55.

U.S. Patent No. 6,813,698 to Gallo et al.

Gallo et al. relates to concurrent configurations of drives of a data storage library with drives of a data storage library concurrently configured. A processor transmits library configuration data separately to each drive, initializes a first configuration process state, with a time-out period, for each drive. A drive responds with a status response, the first process state is updated to "completed". A request for drive unique information is transmitted to the responding drive, advancing the process to a second state. Each of the data storage drives is arranged to acknowledge receipt of the configuration data with a status response. See generally Summary, and col. 7, ln. 45-57.

U.S. Pub. No. 2001/0050915 to O'Hare et al.

O'Hare et al. relates to a multipath multihop remote data facility with a first data storage device being connected to a host, said data operation request being forwarded to said first data storage device and being a multipath multihop system call directing said third data storage device to respond to the data operation request. A depth or level of one associated with the data operation request indicates a first data storage device 32 where a system call may be used to issue a data operation to be performed. See section [0032] and FIG. 2. With a depth of two, for example, if the host processor 34 issues a data operation request to be performed by a second storage data device 36, a remote system call may be used. With a depth of three, the host processor 34 may use a multihop system call, for example, to issue a data operation request to be performed by the third data storage device 40. See sections [0035], [0046].

U.S. Pub. No. 2003/0163553 to Kitamura et al.

Kiramura et al. relates to a storage system and method of copying data. FIG. 7 illustrates local file server 100 that communicates with a plurality of remote file servers 200. As illustrated in FIG. 1, and FIG. 2, a remote copy controller 114 instructs the remote-copying means 122 to copy the actual data 640. See section [0050]. The remote-copy controller 114 confirms whether copying to the magnetic

disk device 223 of the storage device 220 of the remote file server 200 has been performed. See section [0051]. FIG. 9 illustrates local file server 100 connected to remote file server 200A by a private line 500, which is then connected to remote file server 200B by a private line. WAN 300 also provides another connection.

U.S. Pub. No. 2003/0229764 to Ohno et al.

Ohno et al. relates to a data storage subsystem with a remote-copy operation performed from the first subsystem to both of the second and third subsystems in parallel. FIG. 8 illustrates a storage system 150 including first, second, third, and fourth data storage subsystems. See section [0088]. A remote-copy operation is performed from the first subsystem to both of the second and third subsystem in parallel. See section [0088]. A transfer of the updated information received from the first subsystem to the fourth subsystem uses the remote-copy function, which may be in asynchronous transfer. See section [0095]. The remote-copy operation may be suspended while update bit maps 33 and update attribute information tables 36 are prepared to manage the updated information. See section [0096], with FIG. 2 illustrating the attribute table configuration.

U.S. Pub. No. 2005/0033828 to Watanabe

Watanabe relates to a first storage unit system and a second storage unit system connected to each other through a third storage unit system. In general, when executing a remote copy process, the first storage unit system responds to a write request received from a computer to transmit to the third storage unit system a journal having write data received from the computer and address information indicative of a storage position to which the write data is written, thereby writing the journal to the third storage unit system. The second storage unit system receives control information issued by the first storage unit system to read and acquire the journal from the third storage system on the basis of the control information. Then, the second storage unit system follows the address information contained in the journal to write the write data contained in the journal to a disk inside the second storage unit system. See generally sections [0009], [0010], and [0011]. FIG. 17 illustrates an embodiment having an alternate data path. Control information 107 can be forwarded to a secondary subsystem by using a remote copy link. See sections [0181], [0182].

U.S. Pub. No. 2004/0267829 to Hirawaka et al.

Hirawaka et al. relates to a storage system that updates data stored as a journal. FIG. 1 illustrates original storage system 100A connected with secondary storage system 100B. The storage area is managed by partitioning. See section [0035]. The set of logical volumes of the original volume and the secondary volume is a pair. See section [0038]. Pointer information 700 is held for each group to manage the journal logical volume of the group. See FIGS. 3 and 6, and section [0054]. FIG. 9

illustrates that original storage system 110A initiates the initial copying process. See FIG. 9, step 930, and section [0074]. FIG. 10 illustrates the initial copying process. See section [0075]. FIG. 13 illustrates a journal creation process. See section [0091]. FIG. 11 illustrates command reception process 210. When the volume state of logical volume A is "normal," (step 1240), host computer 180 is notified, and the write data is transmitted. See section [0088].

While the above-noted Examiner was consulted and confirmed our opinion that the most relevant areas for this invention were reviewed, further searching may uncover additional patents. NOTE: The field of search included the most pertinent areas identified by the Examiner and our office as containing relevant patents.

As always, if you have any questions regarding this search, please do not hesitate to call us at (703) 413-5000.

Very truly yours,

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TWK/RCP/TEM/nsa
Enclosure

March 7, 2005

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RE: Petition-To-Make-Special Search
For: **REMOTE STORAGE DISK CONTROL DEVICE WITH FUNCTION TO TRANSFER COMMANDS TO REMOTE STORAGE DEVICES**
Your Ref. No.: 340301257US03
Our Ref. No.: HIT 3176.01

Dear Mr. Otsuka:

We have completed the Petition to Make Special search at the U.S. Patent and Trademark Office regarding the above-identified invention. Enclosed with this letter are our draft Petition to Make Special, and paper and electronic copies of patents set forth in our search.

Proposed Amendment to Specification
Page 43, ln. 6, change "2808" to –2802--.
Page 43, ln. 12, after "deleting the," insert --address of the--.

Prioity Date Information
Please note that U.S. Pub. No. 2004/0267829 to Hirakawa et al. is prior art as of its publication date (Dec. 20, 2004), but will become prior art under 35 U.S.C. §102(e) as of Aug. 27, 2003 (before the subject JP priority date) when it matures into a patent. If future search reports should not include these types of references, please advise.

Search Report

The field of search covered Class 711, subclass 112 (U.S. & Foreign). Additionally, a computer database search was conducted on the USPTO systems EAST and WEST for U.S. and foreign patents; a keyword search was conducted in Class 711, subclasses 113, 114, 118, 147, 161 and 202; and a literature search was also conducted on the Internet and commercial databases for relevant non-patent documents. Examiner Reginald Bragdon in Class 711 (Art Unit 2188) was consulted in confirming the field of search.

The search was directed towards a remote storage disk control device with function to transfer commands to remote storage devices. In particular, the search was directed towards claims 1, 19 and 20 of a continuation of U.S. Application Number 10/820629. A remote storage disk control device has a function to transfer commands to remote storage devices. Referring to FIG. 13, data is transferred from primary volume 1101 to primary journal 1103, then from primary journal 1103 to auxiliary journal 1104, and then from auxiliary journal 1104 to auxiliary volume 1102. This is accomplished by way of an "initial copy processing" (pairing information between the journals) and then "journal acquisition processing" (updating the auxiliary volume from the auxiliary journal) – which are executed in response to commands from information processing device 11. FIG. 11 illustrates an initial copy processing, wherein a command is transmitted to the first storage device 10 and second storage device 20 for forming a pair between a third logical volume as a primary volume, and a fourth logical volume as an auxiliary volume. See page 23, ln. 9-14. Pair management sections 704 storage information indicating the states of the pairs in tables 1001. See page 23, ln. 14-17. The second storage device 20 transmits a read request to the storage device 10, and then the second storage device 20 writes the data in an auxiliary volume. See page 23, ln. 17-23. Next, journal acquisition processing is accomplished in FIG. 14, operation S1604, where a journal acquisition request is transmitted to the second storage device. FIG. 14, operation S1609, indicates that the information processing device 11 transmits to the second storage device 20 a restore request to restore journal data up to the read completed LBA 1533. The LBAs are "logical block addresses" which are divided into regions and cyclically read in and out during data transfer. Thus, the claims set forth a first controller receiving a first command which is used to change a relationship between a first logical volume in a third storage device and a second logical volume in a second storage device. The change in relationship reads on the above-referenced embodiment such that the relationship between the logical volumes changes from "initial copying" to "journal acquisition processing."

Please note the enclosed documents listed in numerical order for convenience:

U.S. Patent Number	Inventor(s)
6,247,099	Skazinski et al.

Published Patent Application	Inventor(s)
2003/0229764 *	Ohno et al.
2004/0078535 *	Suzuki et al.
2004/0193795 *	Takeda et al.
2004/0267829 *	Hirakawa et al.

*Patents assigned to Hitachi

Brief Description Of The Documents:

U.S. Patent No. 6,247,099 to Skazinski et al.

Shazinski et al. relates to a method and computer program for maintaining cache coherency amongst a plurality of caching storage controllers. FIG. 4 illustrates that data is copied from local cache 107 of a controller which first receives a write into an alternate controller's cache 108. See col. 6, ln. 53-56. FIG. 5 illustrates a procedure for data synchronization. First controller 106 receives a write and must allocate space, and the second controller receives the same write. See col. 7, l. 24-39. The second controller requests permission to ensure a lock request. See col. 7, l. 24-39. Cache data is then accepted. See col. 7, ln. 50-55.

U.S. Pub. No. 2003/0221077 ('077) to Ohno et al.

Ohno et al. relates to a method for controlling a storage system. FIG. 1 illustrates a host computer 30, and a first and a second storage control apparatuses 10 and 20 each having a function for receiving a data input/output request transmitted from the host computer. A first storage control apparatus 10 organizes one or more logical volumes 11 with each volume referred to by a logical unit number (LUN). See section [0076]. FIG. 6 illustrates a data copy function for processing write-in requests. See section [0112]. The first storage control apparatus 10 transmits to the second storage control apparatus 20 only the data stored in an updated storage area. See section [0126]. FIG. 7 illustrates a snapshot function wherein data is stored in cache memory 13,, a write-in completion report is transmitted to host computer 30 after storage. See sections [0135] - [0137]. An E-copy command permits copying to be carried out between other devices. See section [0198]. The E-copy command is transmitted from the first host computer 31, to a first storage control apparatus, a second storage control apparatus 20, and then to a third storage control apparatus 80. See sections [0200] – [0205].

U.S. Pub. No. 2004/0078535 to Suzuki et al.

Suzuki et al. relates to a system where primary and secondary side systems are provided with plural control units. Primary side composite storage unit system has a plurality ("M" units; 1 to m) of primary side control units (210, 220, 230 and 240). See generally FIG. 1. Each of the primary side control units is connected to processing unit 10. A secondary side composite storage unit system has a plurality ("N" units; 1 to n) of secondary side control units (310, 320, 330 and 340). See generally FIG. 1. With reference to FIG. 4, the secondary side control unit refers to sequential number 701 stored in write data management information table, and checks for a dropout. See section [0046].

U.S. Pub. No. 2004/0193795 to Takeda et al.

Takeda et al. relates to a storage system a storage system where a plurality of storage control apparatuses are interconnected. FIG. 15 illustrates a configuration wherein a logical device 19z and a logical device 18 form a pair of logical devices. See section [0109]. Logical device 19z has its data stored in a second storage device 5z, which is controlled by a fourth storage control apparatus 4z, while logical device 18 has its data stored in a first storage device 13. See section [0109]. FIG. 15 illustrates a control hierarchy in that a target command-processing unit processes a command received from a host apparatus. See section [0115].

U.S. Pub. No. 2004/0267829 to Hirawaka et al.

Hirawaka et al. relates to a storage system that updates data stored as a journal. FIG. 1 illustrates original storage system 100A connected with secondary storage system 100B. The storage area is managed by partitioning. See section [0035]. The set of logical volumes of the original volume and the secondary volume is a pair. See section [0038]. Pointer information 700 is held for each group to manage the journal logical volume of the group. See FIGS. 3 and 6, and section [0054]. FIG. 9 illustrates that original storage system 110A initiates the initial copying process. See FIG. 9, step 930, and section [0074]. FIG. 10 illustrates the initial copying process. See section [0075]. FIG. 13 illustrates a journal creation process. See section [0091]. FIG. 11 illustrates command reception process 210. When the volume state of logical volume A is "normal," (step 1240), host computer 180 is notified, and the write data is transmitted. See section [0088].

While the above-noted Examiner was consulted and confirmed our opinion that the most relevant areas for this invention were reviewed, further searching may uncover additional patents. NOTE: The field of search included the most pertinent areas identified by the Examiner and our office as containing relevant patents.

As always, if you have any questions regarding this search, please do not hesitate to call us at (703) 413-5000.

Very truly yours,

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